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MARINE GEOPHYSICAL SURVEY FOR AN/SQS-26 SONAR, SURVEY PLAN.(U)

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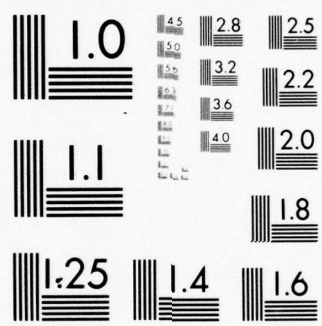

MICROCOPY RESOLUTION TEST CHART

MOST Project-2

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MOST Project-2

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(6) MARINE GEOPHYSICAL SURVEY FOR AN/SQS-26 SONAR,

~~REVISED~~

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SURVEY PLAN.

NAVOCEANO

(11) 31 AUG[redacted]64

(12) 42p.

U. S. NAVAL OCEANOGRAPHIC OFFICE
WASHINGTON, D. C. 20390

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MARINE GEOPHYSICAL SURVEY
FOR AN/SQS-26 SONAR

1. INTRODUCTION

This plan is for the conduct of marine geophysical surveys in support of the AN/SQS-26 sonars has been prepared in accordance with provisions of BUSHIPS letter serial 1610-023 of 1 July 1964. Such surveys are needed immediately so that AN/SQS-26 sonars now programmed into new ship construction can be employed effectively in strategic ocean areas.

The performance of a long range sonar system using surface duct, bottom bounce, and convergence zone propagation is critically dependent upon the oceanic properties that influence the detection path. The major environmental factors affecting the detection statistics and range and bearing accuracy of the AN/SQS-26 sonar system are outlined in Table 1. The survey described in this plan primarily will provide measurements of the static and quasi-static environmental factors ~~on that list~~. The time-varying environmental factors on the list will be provided by <u>in-situ</u> measurements made aboard the sonar-equipped ship and/or from the Anti-Submarine Warfare Environmental Prediction System (ASWEPS).

The rapid completion of this geophysical survey of major strategic areas is one of the most formidable scientific tasks that has ever been undertaken by the U. S. Navy.

TABLE I

MAJOR ENVIRONMENTAL FACTORS AFFECTING AN/SQS-26 SONAR

MODE	ENVIRONMENTAL FACTORS
Surface Duct	Sea State Wind Speed Marine Organisms Horizontal Changes in Near Surface Velocity Near Surface Micro- and Macro-sound Velocity Structure
Convergence Zone	Water Depth How else? Vertical Sound Velocity Structure (Surface to Bottom) Sea State Wind Speed Marine Organisms Horizontal Changes in Near Surface Velocity
Bottom Bounce	Water Depth Bottom Elevation and Slope Spectra Physical Properties of Ocean Bottom Thickness of Sub-Bottom Layers Sea State Wind Speed Marine Organisms Horizontal Changes in Near Surface Velocity

The plan presented here is based on previous extensive exploratory developments, and is a practical, broadscale implementation of techniques and concepts that have been developed by interface programs such as the Long Range Sonar Project at the U. S. Naval Oceanographic Office, BRASS at the U. S. Navy Underwater Sound Laboratory, FASOR at the U. S. Navy Electronics Laboratory, PLUTO at the U. S. Naval Ordnance Laboratory, and SACLANT projects at NATO. Extensive use will be made of contractual and consultant assistance, as appropriate, and the PERT management system so as to assure orderly and timely attainment of objectives.

2. SURVEY OBJECTIVE

The fundamental objective of the Marine Geophysical Survey is to provide to the operating forces environmental information for the CYCLOPS II areas, presented in a format for optimizing decisions on the employment of the AN/SQS-26 sonar.

Table II outlines the major oceanic properties that will be measured during this survey and their influence on the operation of the AN/SQS-26. Techniques required to carry out this program of measurements have been field tested by the U. S. Naval Oceanographic Office during the operational evaluation of the sonar system.

TABLE II

MARINE GEOPHYSICAL SURVEY MEASUREMENTS

Oceanic Property	Influence on Sonar	Measurement	Measurement Accuracy	Field Survey Product
Bottom Reflection Loss	A major variable factor in determining strength of signal received from target in bottom bounce mode	**Normal incidence bottom loss along tracks** **Bottom loss as a function of frequency and angle at stations**	±3 db What does this mean?	Magnetic tape of bottom loss as a function of grazing angle and variation in bottom loss within geological domains
Bottom Depth	Existence of convergence zone depends on depth excess This is an influence?	Echo Sounder (narrow beam) What about CZ measmts?	±1 fm Is this good enough?	Contour Chart
	Operation of bottom bounce mode			Contour Chart
Bottom Slope	Range and bearing accuracy	Echo Sounder	±0.5 deg	Charts of slope showing magnitude and direction
Bottom Roughness	Decrease in signal to noise ratio due to bottom reverberation Is it really?	Echo Sounder (narrow beam)	±1 fm	Bottom Roughness Chart
		Bottom Photographs		Photographic Prints
Bottom Structure		Seismic Profiler Is this good enough	Penetration 3,000 ft Resolution 100 ft	Profiles of sub-bottom structure defines geological domains and governs bottom loss sample selection
		Echo Sounder	Resolution ±1 fm	
Bottom Composition		Cores	30 feet long	"

(Table II continued on next page)

What about multipath & effects on sig coherence?
What is loss dependence on bandwidth, signal type?

TA II (ntir)

Oceanic Property	Influence on Sonar	Measurement	Measurement Accuracy	Field Survey Product
Reverberation Surface (sea surface roughness)	Decrease in signal to noise ratio	Derived From bottom loss measurements and wind speed Risky!	±3 db Huh?	Magnetic tapes of surface reverberation versus sea state and grazing angle. Document validity of Chapman's curve What if it disagrees?
Volume (Biological or chemical)	"	Scattering from deep scattering layer	±3 db	Magnetic tape of volume reverberation including short term variability of acoustic properties of deep scattering layer
Bottom (Bottom roughness)	"	Bottom reverberation as a function of grazing angle	±3 db	Magnetic tapes of bottom reverberation as a function of grazing angle
Sound velocity Structure from surface to bottom	Surface Duct Detection Range, Bottom Bounce, Tilt Angle. Convergence zone; width, range and probability of occurrence	Sound velocity profile Time series temperature profile Limited Nansen casts Salinity	±3 ft/sec	Document deep velocity structure. Determine near surface variations in time and space All oceanographic data on magnetic tape

What is the relationship between back scattered energy & fwd scattered energy? (~~As~~ a fn of BW?)

3. DESCRIPTION OF SURVEY PROGRAM

3.1 General

The vast area to be covered by the Marine Geophysical Survey and the limited time available to complete the program precludes all possibility of conducting a detailed grid-type survey. The underlying hypothesis of the measurement program is that the ocean floor is divisible into acoustic provinces which are controlled by physiographic and geologic parameters. A sample of the acoustic properties of each province will be carefully selected. The samples must be chosen so that a few measurements accurately represent an entire province. The R&D efforts of the Long Range Sonar Project in conducting environmental surveys in support of the AN/SQS-26 program have indicated that such a sampling procedure is feasible.

The services of consultants who are experts in the submarine geology and oceanography of specific survey areas will be utilized to insure that the sampling techniques are optimum and that the samples are adequate to describe the marine environment.

Division of the ocean floor into provinces will be made initially on the basis of existing acoustic and bathymetric data. As part of this initial examination of existing information, areas that are too shallow, have slopes that are too steep, or have other features like what? precluding bottom bounce or convergence zone modes of operation of the SQS-26 sonar, will be eliminated from

the total area to be surveyed. The remaining portion of each major division will be classified into task areas based on similarities in physiography and geology. Measurements of the acoustic and oceanographic properties of each task area will then be made.

A preliminary survey will determine the validity of the initial classification of the task areas. The number and location of acoustic stations, temperature-array buoy plants, cores, and profiler lines will be determined by the variability of the acoustic and oceanographic properties of each area, and by the quality and quantity of historical data.

3.2 Measurements

Water mass measurements will include the use of sound velocimeters, Nansen casts, and taut line buoyed thermistor arrays to provide information on the sound velocity structure and the limits of its short-term fluctuations. Bottom and sub-bottom properties will be investigated with explosive sound sources, echo sounders, magnetometers, cores, and sub-bottom profilers.

Based on experience gained in conducting environmental surveys for the operational evaluation of the AN/SQS-26 sonar, the following factors will be measured to determine acoustic and oceanographic parameters of the task areas:

1) Bottom reflection loss - Bottom loss as a function of frequency and grazing angle will be measured using explosive charges at discrete locations throughout each task area. In addition, normal incidence bottom loss will be measured along ships' tracks.

2) Reverberation - The reverberation measurements will be an integrated phase of the bottom loss measurements. Surface and volume reverberation will be related to wind speed and scattering layer, respectively.

3) Bathymetry - Bathymetry will be measured with a narrow-beam echo sounder to permit slope computations as well as qualitative estimates of bottom roughness.

4) Sub-bottom profiling - Shallow sub-bottom layering will be measured with a short-pulse echo sounder. Reflections from deeper horizons obtained with a sub-bottom profiler such as a sparker will be used to delineate acoustically similar provinces. ?

Are shallow water sediments like deep water sediments?

5) Magnetic intensity - Total magnetic intensity profiles will assist in dividing strategic areas into geologic provinces.

6) Sound velocity - Surface to bottom sound velocity profiles will be used to determine sonar ray paths, propagation loss, and to process acoustic data. Measurements will be made with deep sound velocimeters.

7) Temperature variations - A series of buoyed thermistor arrays will be planted throughout the operating areas

to obtain time-series temperature data to 1500 meters depth. Surface to bottom Nansen casts will verify the structure of the vertical sound velocity profile.

Supplemental information will be obtained with the bathythermograph and surface towed thermistor.

8) Coring - Cores will be analyzed for mass physical properties in order to formulate and test mathematical models for the prediction of sonar performance.

9) Bottom photography - Bottom stereo-photographs will be made at selected locations to determine characteristics of topographic micro-relief.

3.3 Instrumentation

One ship will be equipped as a shooting ship, and the other as a recording ship. No new development of instruments will be required for this project. All instrumentation required is readily available from commercial sources. Table III lists the minimum instruments necessary to outfit a shooting ship and a recording ship.

3.4 Description of Field Operations

Surveys will be performed in the oceanographic/acoustic provinces within the CYCLOPS II strategic areas. Each task area survey will require a recording ship and a shooting ship.

Field operations will begin with the preliminary survey. During this phase, both ships will independently follow carefully selected tracks through the area, towing magnetometers,

TABLE III

SURVEY INSTRUMENT REQUIREMENTS

Type of Measurement	Ship	Instrument Required
1. Grazing Angle Reflection Loss and Reverberation	Recording Shooting Both Shooting	Acoustic Signal Receiving System Shot - Instant Recorder Single-Side Band Radios Explosives
2. Normal Incidence Bottom Loss	Both	Normal Incidence Reflectivity System
3. Bottom Slope, Bathymetry, and Roughness	Both	Short (.2 msec) Pulse Narrow Beam Echo Sounder
4. Sub-bottom Layering What ? Top-bottom Layering ?	Both	a. Continuous Reflection Profiler b. Short Pulse, Narrow Beam Echo Sounder
5. Coring (Bottom Composition)	Recording	Ewing Corer
6. Magnetic Profiles	Both	Proton Magnetometer
7. Surface to Bottom Sound Velocity Profiles	Both	Velocimeter
8. Short-term Temperature Variations	Both	Buoyed Thermistor Array
9. Layer Depth and Surface Temperature	Both	a. 900-foot Bathythermographs b. Thermistor and Recorder
10. Wind Speed	Both	Anemometer
11. Velocity of Sound in Sediments	Recording	Sediment Velocimeters
12. Bottom Photographs	Both	Deep Sea Stereo Camera

sub-bottom profilers, and surface temperature thermistors. Simultaneously, a short pulse, narrow beam echo sounder will be operated, and normal incidence bottom loss measurements will be made. Seismic sub-bottom reflection data will be obtained to a depth of 3000 feet below the water-sediment interface and recorded on both graphic recorder and magnetic tape. During the preliminary survey, the buoyed thermistor arrays will be planted.

At the end of the initial phase, the validation data will be reviewed, and the NAVOCEANO representative will make the final decision concerning the locations of the acoustic stations.

At each acoustic station, the recording ship will remain stationary, while the shooting ship opens range and drops charges at a rate sufficient to give reflection angles no more than 2 degrees apart. The measurements at one acoustic station will consist of reverberation and grazing angle measurements from normal incidence to the first convergence zone. Ship-to-ship distances and water depths will be determined with a precision necessary to assure adequate control over the geometry of the acoustic paths. All bottom loss and reverberation data will be recorded and retained on magnetic tape.

good trick!

accidental?

The geometry of the bottom loss measurements will be designed so as to yield both bottom loss, boundary, and volume reverberation from the same set of measurements.

At selected locations, bottom photographs and cores will be obtained for subsequent analysis.

Between acoustic stations, one ship will record sub-bottom profiles and the other will record normal incidence bottom reflection losses to indicate the degree of acoustic uniformity. To what degree?

While underway, data processing and analysis will be accomplished on a continuing basis to assure that the quality of data is in keeping with the desired survey end products.

3.5 Survey Schedule

The total survey program has been subdivided into twenty survey tasks spaced over a period of three years as indicated in Figure 1. Four such tasks will begin the first year, eight the second year, and eight the third year. Each task will require two ships and will be completed in a 100-day period of field operations consisting of approximately four periods of 21 days at sea and four days in port. The 20-day interval between tasks for a given ship will allow for shifting of ships' schedule as required by ship downtime, transfer of ships to different areas, etc.

It is proposed that the program begin with simultaneous surveys in the western Atlantic and the Norwegian Sea. These areas have been selected for initial field operations because the information required to plan the surveys there, is most detailed. The experience gained by first surveying these areas

will permit more efficient planning and surveying of areas where information is meager. The area and number of tasks to be completed in each are as follows:

Mediterranean Sea	-	2
Norwegian Sea	-	2
East Atlantic Ocean	-	3
West Atlantic Ocean	-	2
East Pacific Ocean	-	6
West Pacific Ocean	-	5
Total	-	20

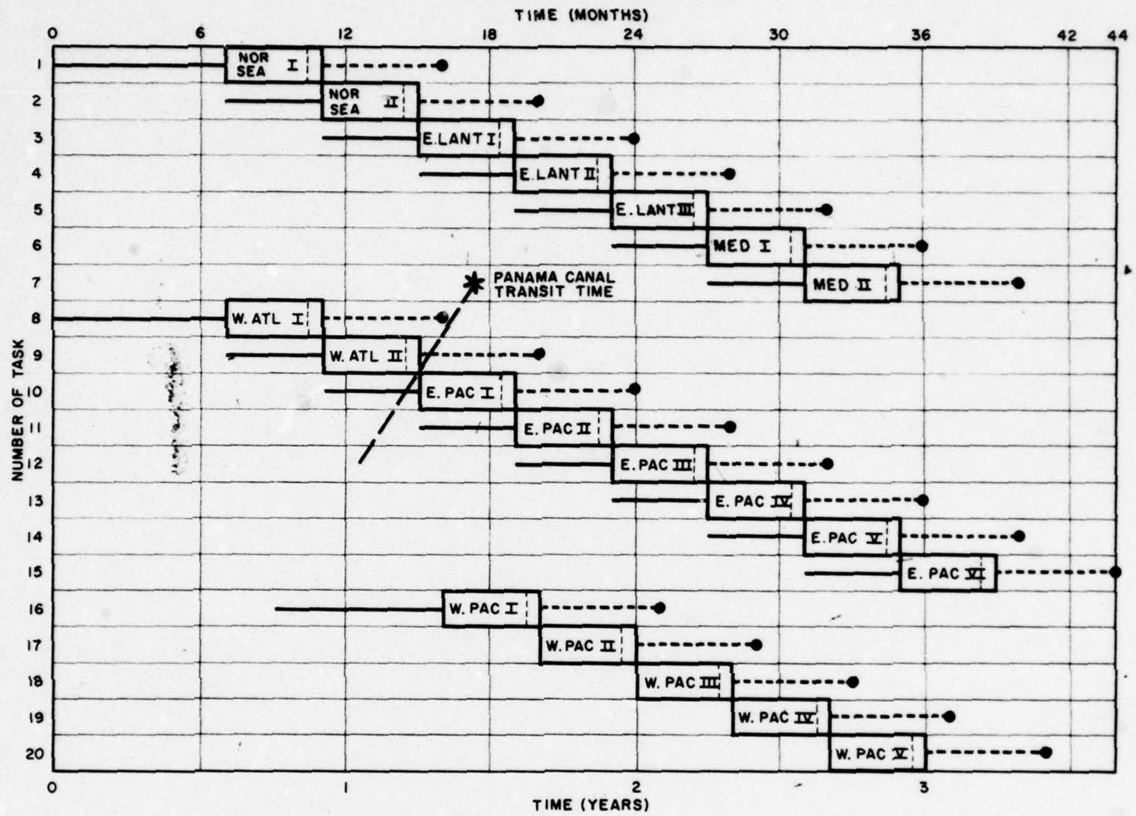
The above listing was compiled on the basis of 100 acoustic stations per Marsden square. Cost estimates and scheduling are based on the completion of a Marsden square in 50 days.

3.6 Ship Requirements

The total estimated ship-time required to complete this program is 13.2 ship-years. This estimate includes 11.0 ship-years for survey time and 2.2 ship-years for equipment installation and transit time. Six ships will be required to complete this program on the planned schedule as shown in Figure 1.

It is planned that the survey will be conducted with contract ships obtained through or operated by MSTS, in accordance with established Navy policy.

SURVEY SCHEDULE



PLANNING
1. SURVEY SPECS
2. ADVERTISE REQUEST FOR PROPOSAL
3. BID REVIEW
4. CONTRACT AWARD
   7 MONTHS FOR INITIAL SURVEYS
   4 MONTHS FOR SUBSEQUENT SURVEYS

SURVEY (120 DAYS) - 2 SHIP OPERATIONS
A. EQUIPMENT INSTALLATION } 20 DAYS
B. TRANSIT TIME
C. ON-STATION TIME
   4 PERIODS OF 21 DAYS AT SEA AND 4 DAYS IN PORT } 100 DAYS

CONTRACTORS REPORT (5 MONTHS)

FIGURE 1

3.7 Navigation

Navigational aids in all task areas are satisfactory for surveys for the AN/SQS-26 sonar. LORAN C is available in the western Atlantic Ocean, the Norwegian and the Mediterranean Seas, thus, data collected in those areas will be located with sufficient accuracy for use on most other current oceanographic projects.

3.8 Final Survey Products

All recording and processing of data from the survey will be automated insofar as possible in order that necessary statistical and theoretical computations can be made rapidly. The format for the final products of this survey will be determined by the requirements of the sonar conversion techniques to be used by the operating forces. Recommendations for these formats will be an early responsibility of the advisory board to be established as provided in section 5.2.

All basic data from the survey will be recorded on magnetic tape for transmittal to NAVOCEANO. Explosive data will be processed to yield bottom loss and reverberation as a function of grazing angle for frequencies of interest. Magnetic tape recordings will be made of the processed data which will serve as the computer input for statistical and theoretical calculations and interpretations.

Bathymetric data received from the survey will be combined with all existing data and revised charts constructed. In addition, all bathymetric data taken during this survey will be automated in a format compatible with NAVOCEANO computers. Bottom slope charts will be compiled.

At about 18 months after the initial start of the survey program, a field test will be conducted to establish validity of survey products in terms of their applicability to the operations of the AN/SQS-26 sonar. This validation will be made by an AN/SQS-26 sonar-equipped ship operating in a surveyed area, where it will evaluate actual sonar performance in comparison with predicted performance based on results of the environmental survey.

4. AN/SQS-26 SONAR DECISION CRITERIA

The Marine Geophysical Survey data will be an input, along with necessary dynamic environmental data, to establish operational decision criteria, as indicated in Table IV, in support of AN/SQS-26 sonar operation.

TABLE IV

AN/SQS-26 SONAR DECISION CRITERIA

MODE	DECISION CRITERIA
All Modes	Optimum sonar operating mode
	Range and probability of sonar detection under given operating and environmental conditions
	Mean horizontal and ray path sound velocity: direct path, convergence zone, bottom bounce
	Sonar range and bearing errors due to horizontal changes in sound velocity — Not learned from MGS
	Optimum pulse length and ping rate
	Optimum deployment of forces
Surface Duct	Areas and times for surface duct operation
	Sonic layer depth
	Surface duct sound velocity
Convergence Zone	Areas and times for convergence zone operation (sufficient depth excess)
	Convergence zone range and width
	Optimum depression angle
	Probability of convergence zone
	Convergence zone search range
Bottom Bounce	Areas and times for bottom bounce sonar operation
	Sonar range and bearing errors (bottom slope)
	Optimum bottom bounce depression angle — Regardless of desired range?
	Bottom bounce search start range

5. MANAGEMENT PLAN

5.1 General

The management of the Marine Geophysical Survey for AN/SQS-26 Sonar will be the responsibility of the Commander, U. S. Naval Oceanographic Office. This responsibility includes both the administration and technical direction of the survey, under the broad, general direction and control of the AN/SQS-26 Sonar System Project Office. The latter retains the overall responsibility for the satisfaction of program objectives in support of the AN/SQS-26 program, and the funding responsibility thereof.

Program evaluation and review techniques (PERT) will be used to assure that survey specifications and schedules are met.

A program manager from the U. S. Naval Oceanographic Office will direct the survey operations and the reduction of the data in terms of AN/SQS-26 requirements.

The time factor precludes conducting this survey wholely on an "in house" basis. Procurement delay time, and the time required to hire and train an adequate number of personnel make it unrealistic to attempt this survey "in house." Therefore, much of the measurement and data reduction phases of the survey will be accomplished by contract.

Contractors will furnish the instruments, manpower, and certain aspects of the field management necessary to conduct the survey. Contractors will be directly responsible to the program manager who will assign NAVOCEANO project staff members to the survey ships in a liaison capacity.

5.2 Marine Geophysical Survey Advisory Board

A committee will be established to serve in an advisory capacity to the Marine Geophysical Survey ~~project~~ PROGRAM manager. This committee, to be called the MGS Advisory Board, will be formed and will meet immediately after the plan for the MGS is approved, and thereafter on a regular basis at the call of the Chairman or the AN/SQS-26 Sonar System Project Office. The Advisory Board initially will consist of one member each from the following agencies or laboratories:

Naval Oceanographic Office (Chairman)
Navy Underwater Sound Laboratory
Navy Electronics Laboratory
Naval Ordnance Laboratory
AN/SQS-26 Sonar System Project Office (Ex-Officio)
Oceanographer of the Navy (Ex-Officio)

Assistance and advice shall be requested from the following organizations, and personnel therefrom shall be invited to participate in those Board meetings considered pertinent to their areas of authority:

Chief of Naval Operations
Chief of Naval Material
Bureau of Ships
Bureau of Naval Weapons
Naval Research Laboratory

Naval Research Establishment of
Defense Research Board, Canada
NATO SACLANT ASW Research Center, La Spezia
Admiralty Underwater Weapons Establishment,
Great Britain
Private geological and oceanographic organizations

5.3 Management Reporting

The program manager shall present to the regularly scheduled Board meeting, an up to date status of the program, including status of achieving milestones, and PERT time predictions, of financial status, both predicted and actual status of survey results. Invitation of other than the Board members should be arranged when the program manager will present items of great significance to the ASW program.

5.4 Consultants

Consultants will be used as appropriate in all major aspects of survey planning and operations. This use of consultant advice will facilitate making optimum use of available survey raw materials and to ensure a final product consistent with the objectives of the program.

Technical consultants are expected to be used in the following areas:

1) AN/SQS-26 Requirements - details of the theory, design, production, and applications of the sonar itself.

2) Fleet Requirements - inputs to planning of survey program and format of final product based on fleet operational experience.

3) Submarine Geology and Geophysics - definition of domains for planning survey track lines and sample points.

4) Underwater Acoustics and Oceanography - details of reverberation measurement techniques and fleet ASW applications; the applications of explosive signals to the measurement of acoustic variables at sonar frequencies - oceanometrics.

5.5 Program Evaluation and Review Technique

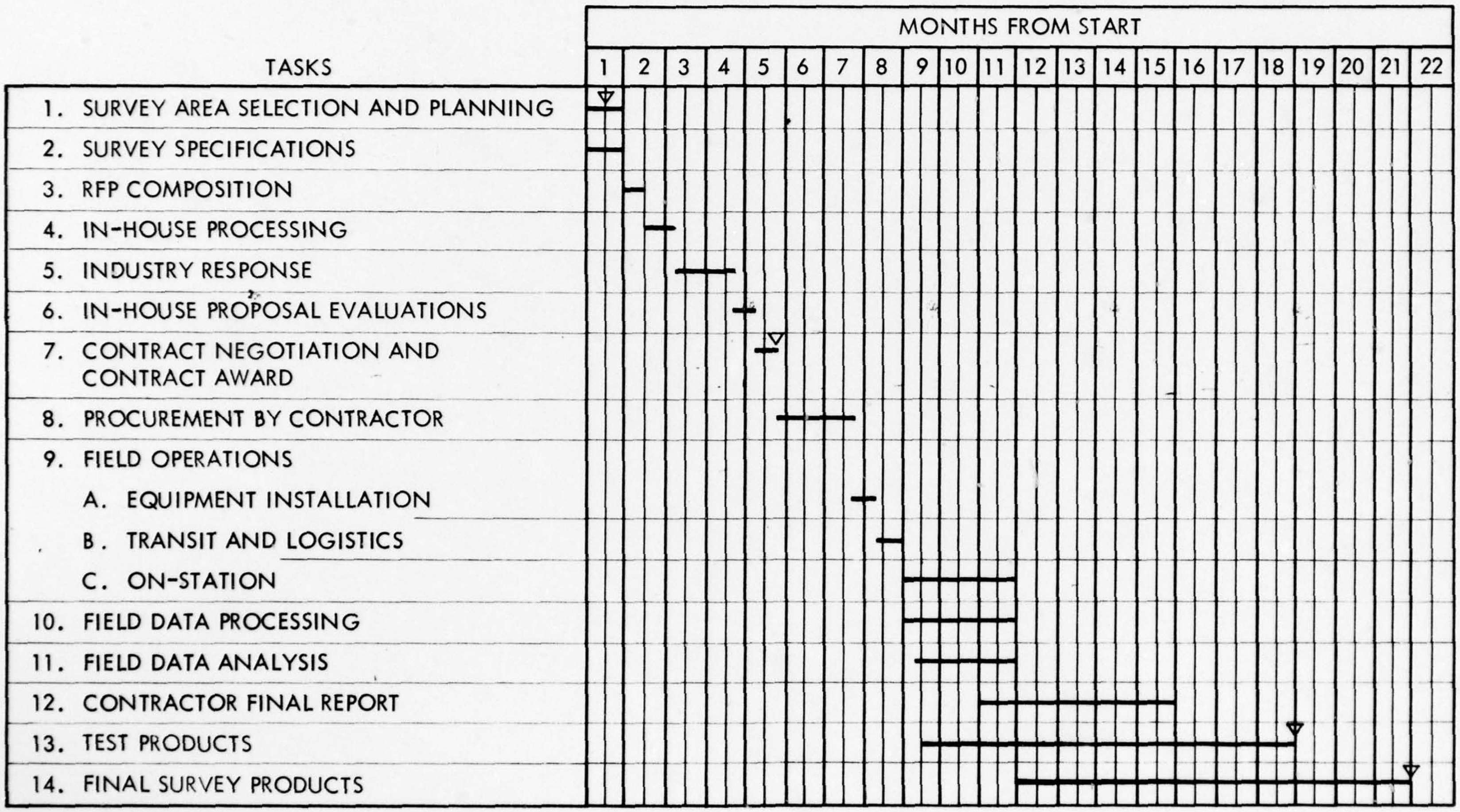
As a preliminary basis for a Program Evaluation and Review Technique (PERT) network, a single 100-day survey task is outlined by milestones in Figure 2. This milestone chart includes the steps necessary for accomplishment of a successful survey. Points at which major decisions are required are also indicated on this chart. The survey results will be delivered 16 months from the start, and the final analysis will be completed 22 months from start.

In order to use most effectively the available raw materials (manpower, money, ships), a PERT program has been prepared which takes into account the constraints imposed by the availability of manpower, funds, suitable vessels, and the target date for completion, (Figure 3).

Use of this PERT time network will permit the early detection and correction of slippages or program slow-downs caused by major equipment breakdowns, procurement delay times, unfavorable weather conditions, etc.

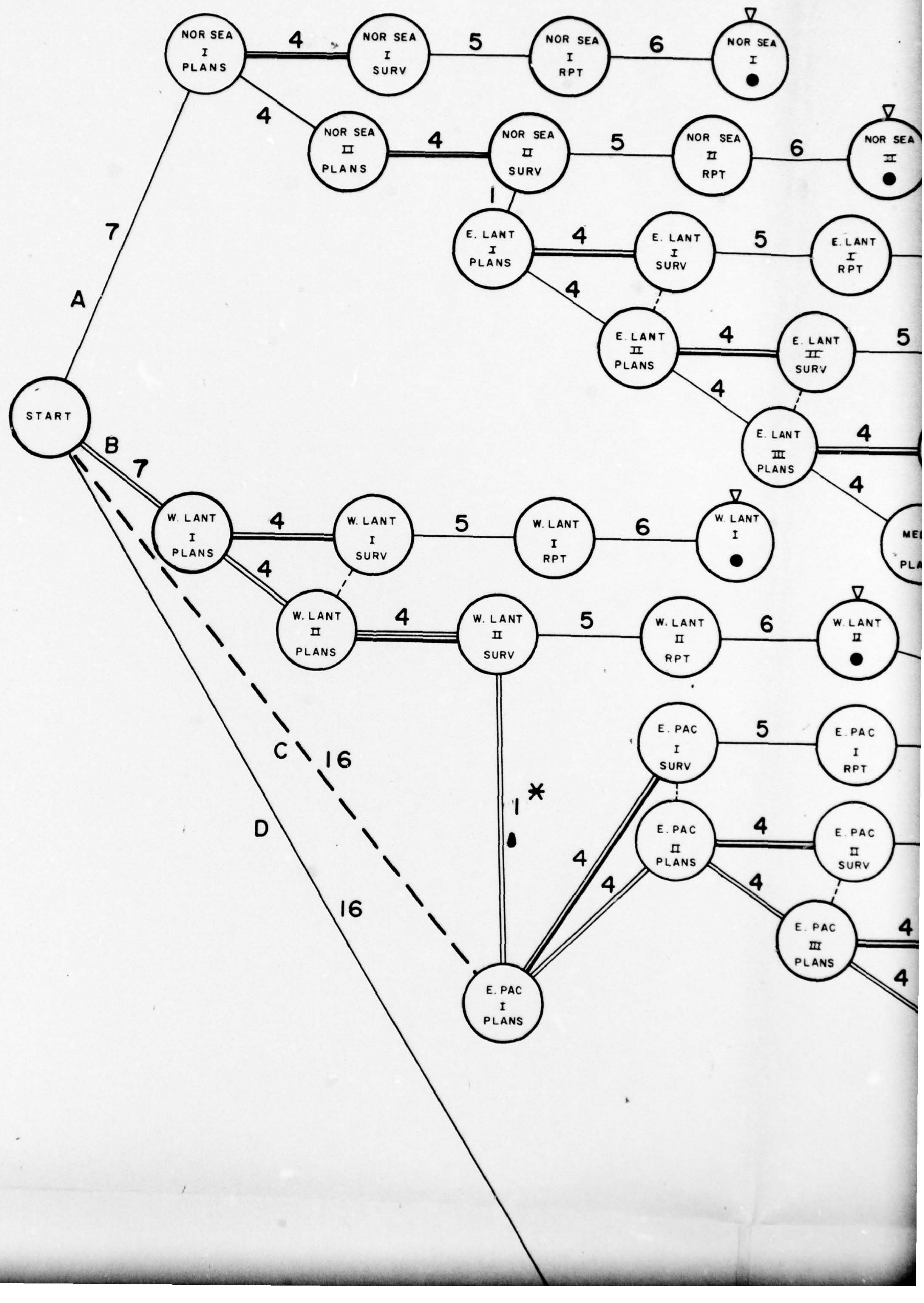
MILESTONE CHART

INITIAL TASK AREA



▽ MAJOR DECISION

FIGURE 2



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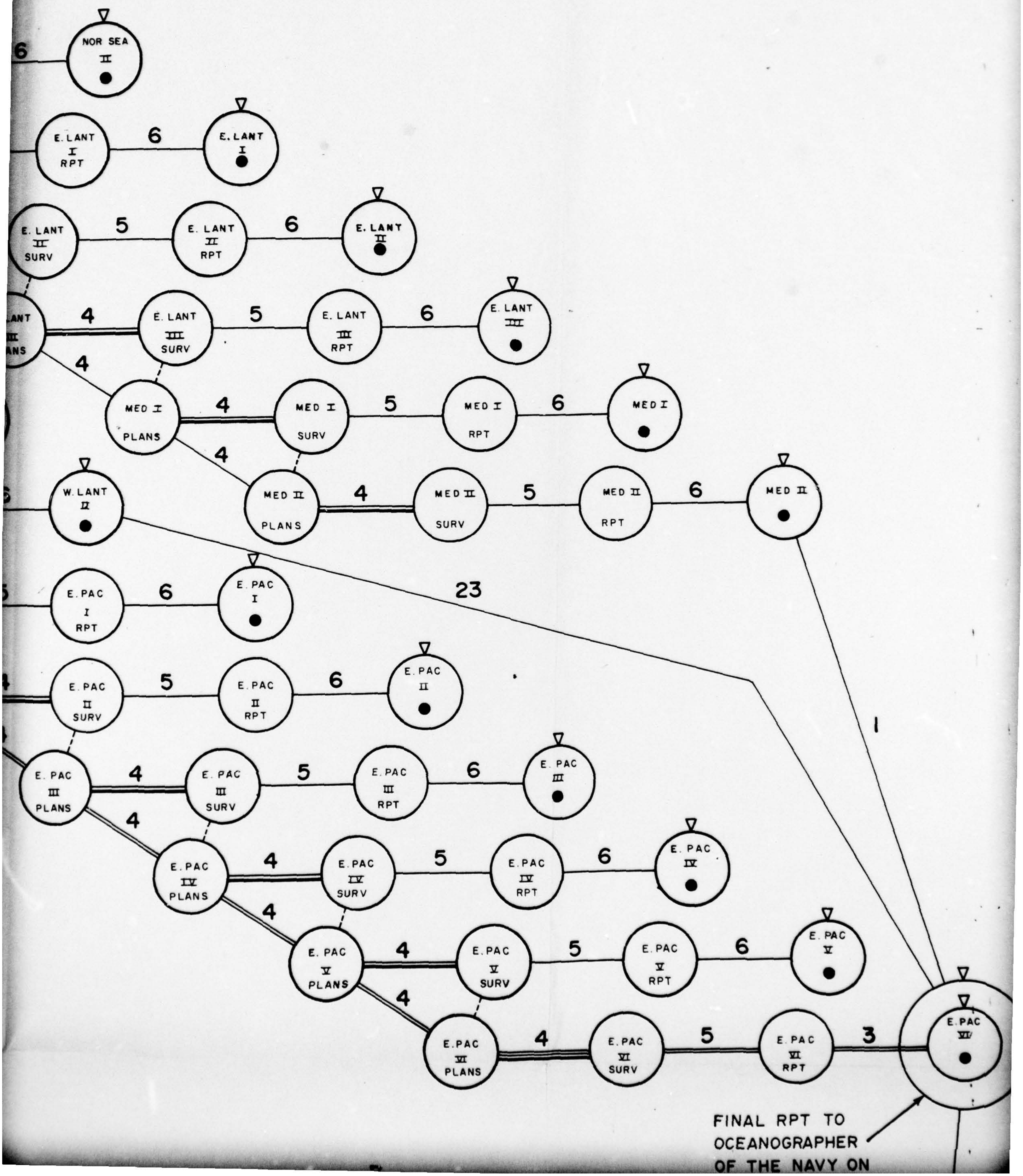
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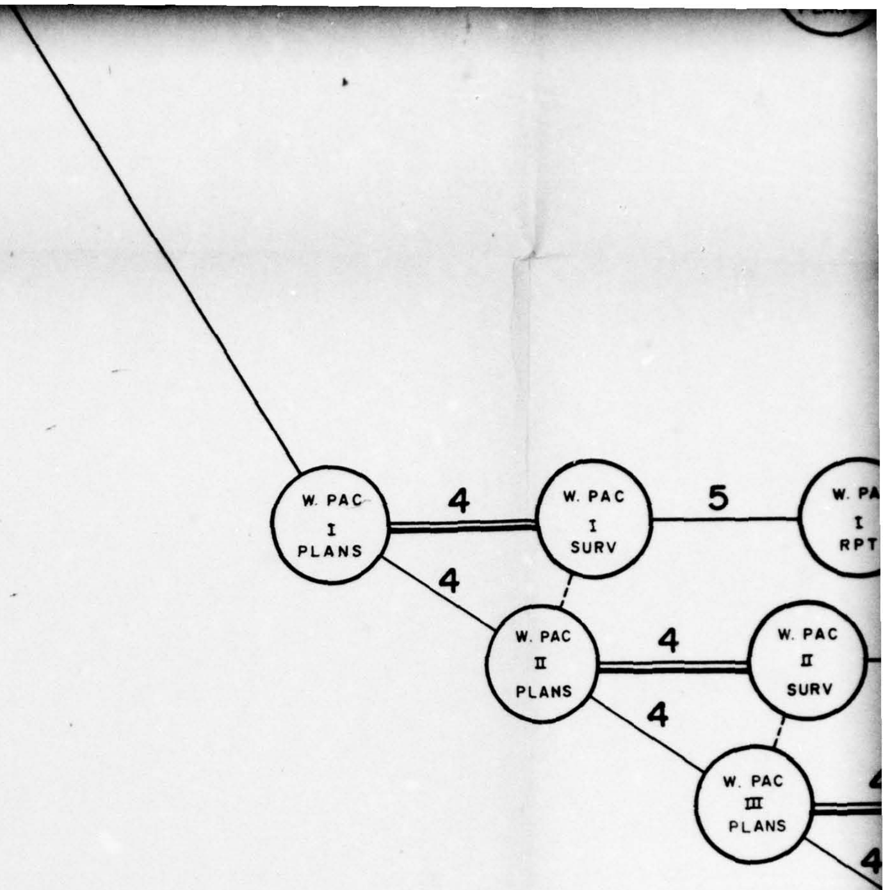


4, 5, 6, ETC. TIME (MONTHS)

CRITICAL PATH

SHIPS DEPLOYED

FINAL SURVEY PRODUCT

A CONTRACT - MEDITERRANEAN (MED.), NORWEGIAN SEA (NOR. SEA), EASTERN ATLANTIC (E. LANT)

B CONTRACT - WESTERN ATLANTIC (W. LANT)

C CONTRACT - EASTERN PACIFIC (E. PAC)

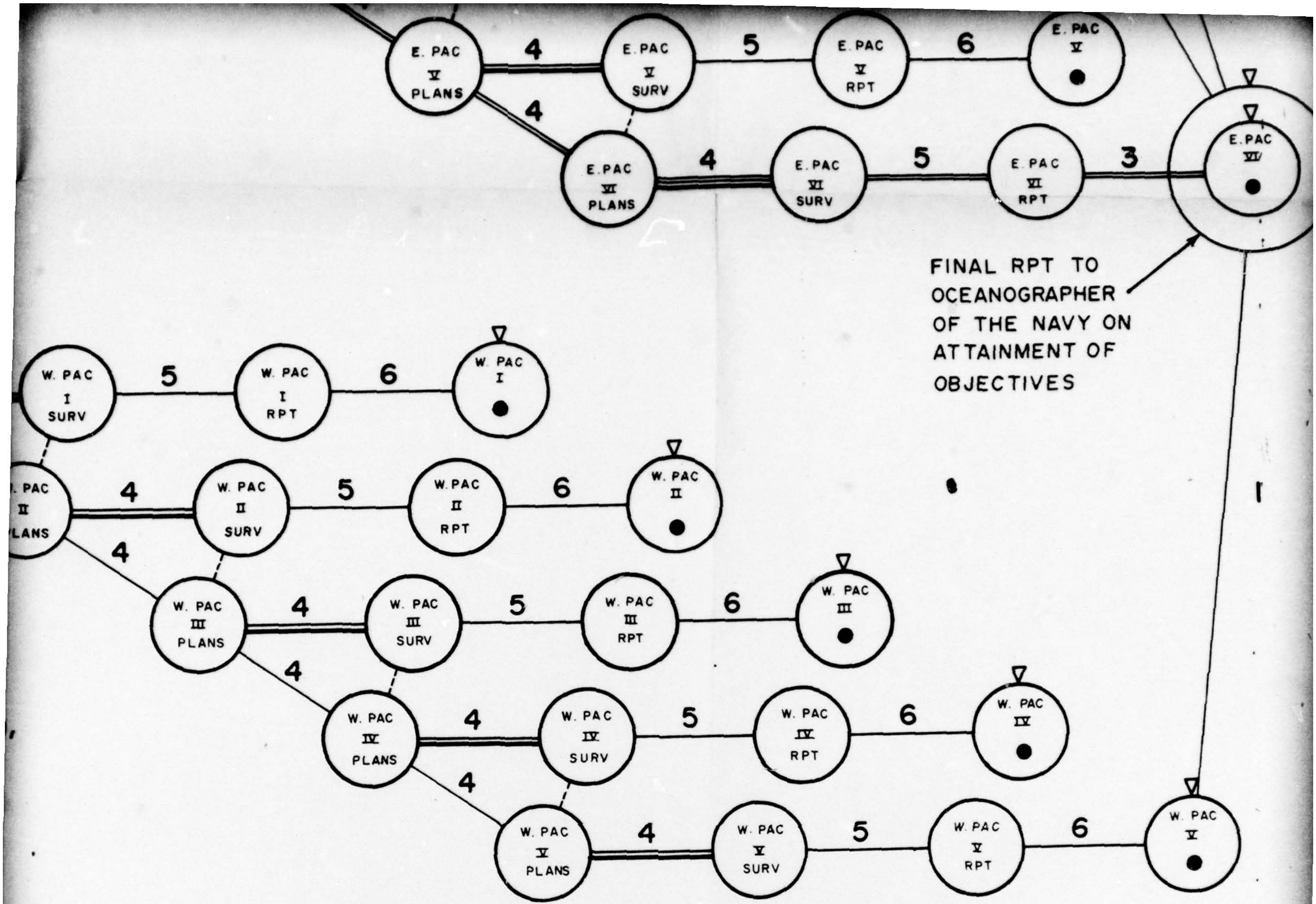
D CONTRACT - WESTERN PACIFIC (W. PAC)

PLANS
SURVEY SPECS
RFP
BID REVIEW
CONTRACT AWARD

SURVEY (SURV)
EQUIPMENT INSTALLATION
TRANSIT TIME
ON-STATION TIME

* DENOTES PANAMA CANAL TRANSIT TIME IF CONTRACTS "B" AND "C" ARE COMBINED

PERT TIME NET
MARINE GEOPHYSICAL
IN SUPPORT O
AN/SQS-26 SONAR P
FIGURE 3



ERT TIME NETWORK
INE GEOPHYSICAL SURVEY
IN SUPPORT OF
/SQS-26 SONAR PROGRAM
FIGURE 3

5.6 Financial Plan

The cost estimates for the Marine Geophysical Survey are based on past experience of similar surveys in support of AN/SQS-26 operational evaluation. The accompanying budget for FY65, Table V, and cost breakdown sheet, Table VI and Table VII, present the financial structure of the program.

The financial plan was developed to conform with the management plan and is designed to ensure that the objective of the program will be met on schedule. Program management will be accomplished "in house," and the technical work (i.e., surveys, data reduction, and presentation) will be accomplished by contract. Consulting services for management and technical advice as necessary will be obtained by contract.

5.7 Personnel Plan

A project task force within the U. S. Naval Oceanographic Office will accomplish the management objectives of the Marine Geophysical Survey. A project manager will direct the program and assemble a support staff to provide the necessary liaison with contractors during field operations. Figure 4 is a schedule of projected manpower levels by month. An adequate number of oceanographers and geophysicists are available in the Oceanographic Office to initiate the program. Additional personnel will be recruited and trained during the first 12-month period.

TABLE V

MARINE GEOPHYSICAL SURVEY FY65 BUDGET

Category	Regular Man Years	Regular Man Yrs Cost	Overhead Cost	Travel	Rent	Contracts	Supplies	Equipment	Total Cost
Plans, Specs.	15.5	133,300	32,030	5,000	-	-	15,000	-	185,330
Data Collection	4.5	41,800	6,000	10,000	-	1,800,350	200,000	511,000	2,569,150
Compilation and Reports	8.5	73,100	17,420	5,000	30,000	100,000	20,000	-	245,520
TOTALS	28.5	248,200	55,450	20,000	30,000	1,900,350	235,000	511,000	3,000,000

TABLE VI

TOTAL COST OF MARINE GEOPHYSICAL SURVEY

I.	FIELD OPERATIONS	
	A. Personnel	$ 1,000,000
	B. Equipment	2,000,000
	C. Materials	200,000
	D. Explosives	1,300,000
	E. Ship Charter	4,000,000
	Total Field Operations.....	$ 8,500,000
II.	DATA REDUCTION AND ANALYSIS	
	A. Personnel	$ 1,000,000
	B. Materials	100,000
	C. Computer	400,000
	Total for Data Reduction and Analysis.............	$ 1,500,000
	TOTAL FOR SURVEY......	$10,000,000

TABLE VII

COST ESTIMATES BY AREA

Area	1st YEAR		2nd YEAR		3rd YEAR		TOTAL	
	Field Ops (days)	Total Cost (thousands)	Field Ops (days)	Total Cost (thousands)	Field Ops (days)	Total Cost (thousands)	Field Ops (days)	Cost (thousands)
NORWEGIAN SEA	200	1,000	---	---	---	---	200	1,000
WEST ATLANTIC OCEAN	200	1,000	---	---	---	---	200	1,000
EAST ATLANTIC OCEAN	---	---	200	1,000	100	500	300	1,500
MEDITERRANEAN SEA	---	---	200	1,000	---	---	200	1,000
WEST PACIFIC OCEAN	---	---	200	1,000	300	1,500	500	2,500
EAST PACIFIC OCEAN	---	---	300	1,500	300	1,500	600	3,000

Total........ 10,000

Note: Cost includes field operations and data reduction.

Obligation of funds for each year will be as follows:

1st Year	$ 3,000,000
2nd Year	4,000,000
3rd Year	3,000,000
Total........	$ 10,000,000

U.S. NAVAL OCEANOGRAPHIC OFFICE
MANPOWER REQUIREMENTS
MARINE GEOPHYSICAL SURVEYS FOR AN/SQS-26

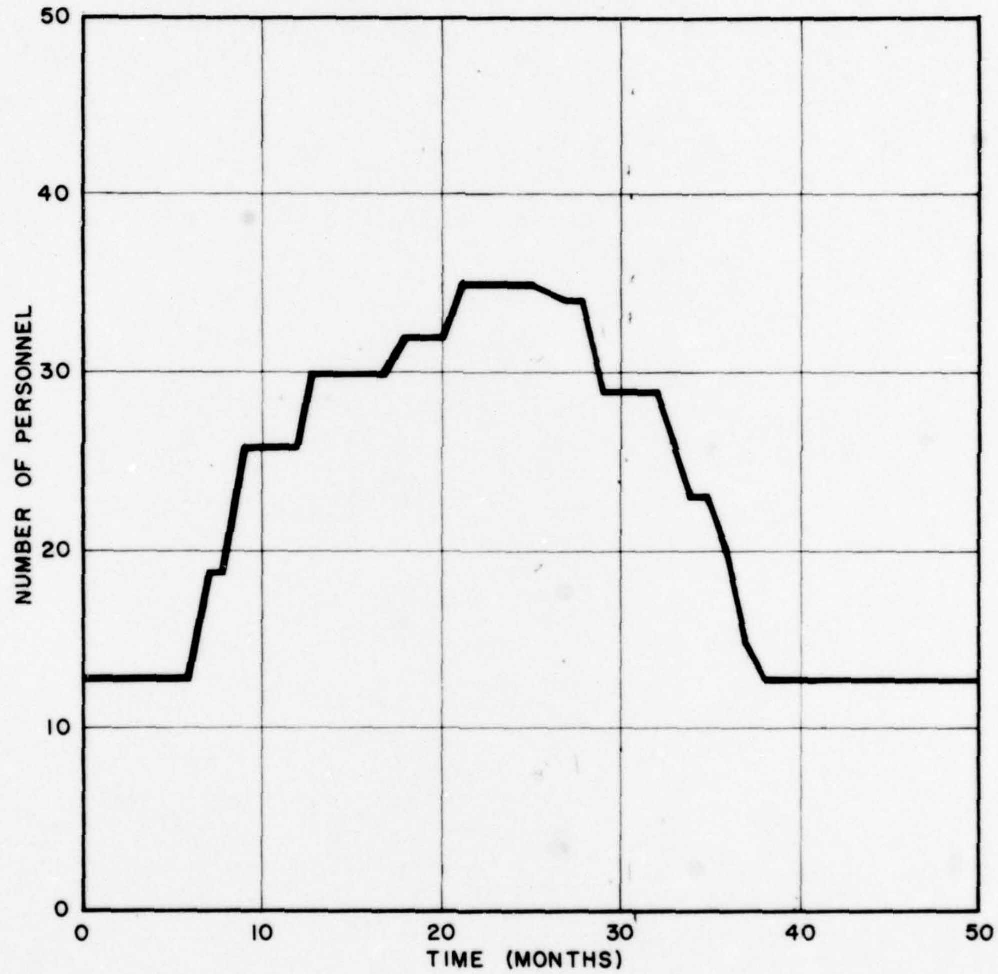


FIGURE 4

6. TECHNICAL RISKS

Technical risks in this program can be divided into two classes. First, those imposed by the sampling techniques to be used for the measurements, and second, those arising from the applicability of the survey measurements to operations of the AN/SQS-26 sonar.

6.1 Risks Imposed by the Sampling Techniques

Since the time limitation imposes severe restrictions on the density of data, a sampling process has to be devised. Recent work has shown that large areas exist which exhibit small acoustic variability. These studies suggest that an adequate description of large areas with few samples is feasible. The method employed to reduce the risk of inadequate sampling is to conduct normal incidence measurements while underway during the preliminary surveys and between the acoustic stations. These normal incidence measurements will validate the continuity of the acoustic variations within the survey areas.

6.2 Risks Imposed by the Application of the Measurements

The acoustic data collected will be obtained by using explosives as a sound source. The explosive sound source differs from the sonar in that the explosive has a broad band frequency and a short pulse length as opposed to the narrower frequency band and longer pulse length of the sonar. Evidence obtained

during the Operational Evaluations for the AN/SQS-26 sonar indicates that explosive data are applicable when properly processed. The Long Range Sonar Project is conducting a further study which will minimize the risks of using explosive data. This study will verify the applicability of the explosive data and the optimum processing methods for use with the AN/SQS-26 sonar. This study will be completed prior to the beginning of the marine geophysical survey.

I doubt!!

The alternative and less desirable method of measurements is to use high energy, fixed frequency transducers as sound sources. Explosive sources have an advantage over other types of sound sources in that a change in the frequency or pulse length of the sonar will not necessitate obtaining new data since it will be inherent in the raw data of the explosive. Such a change would only require the reprocessing of the explosive data.

Not necessarily true. It seems to me to depend upon the type of processing one is going to do — coherent or incoherent. BW ~~bee~~ or resolution becomes extremely important here — say, if you have a signal resolution of 1-ms, it is conceivable that different bottom loss values can be obtained by analyzing the data with a more or less resolute receiver.

There is no mathematical formulation to support this assumption. If an impulse ($\int^T \delta(t)\,dt = 1$) is used, and if the bottom (or surface) ~~gives~~ goes a linear ~~reflect~~ process of reflection, then & only then

Can you predict or calculate the response over a narrow (relative) band of frequencies. I'm not saying that the bottom will respond, say, to 5KC in one manner when excited by a linear FM pulse 200~ wide 4.9 - 5.1 KC and then respond in another manner to 5KC when excited by a wide band pulse with 0-20KC width, but it does appear risky to process shot data using a 10 ms averager after detection.

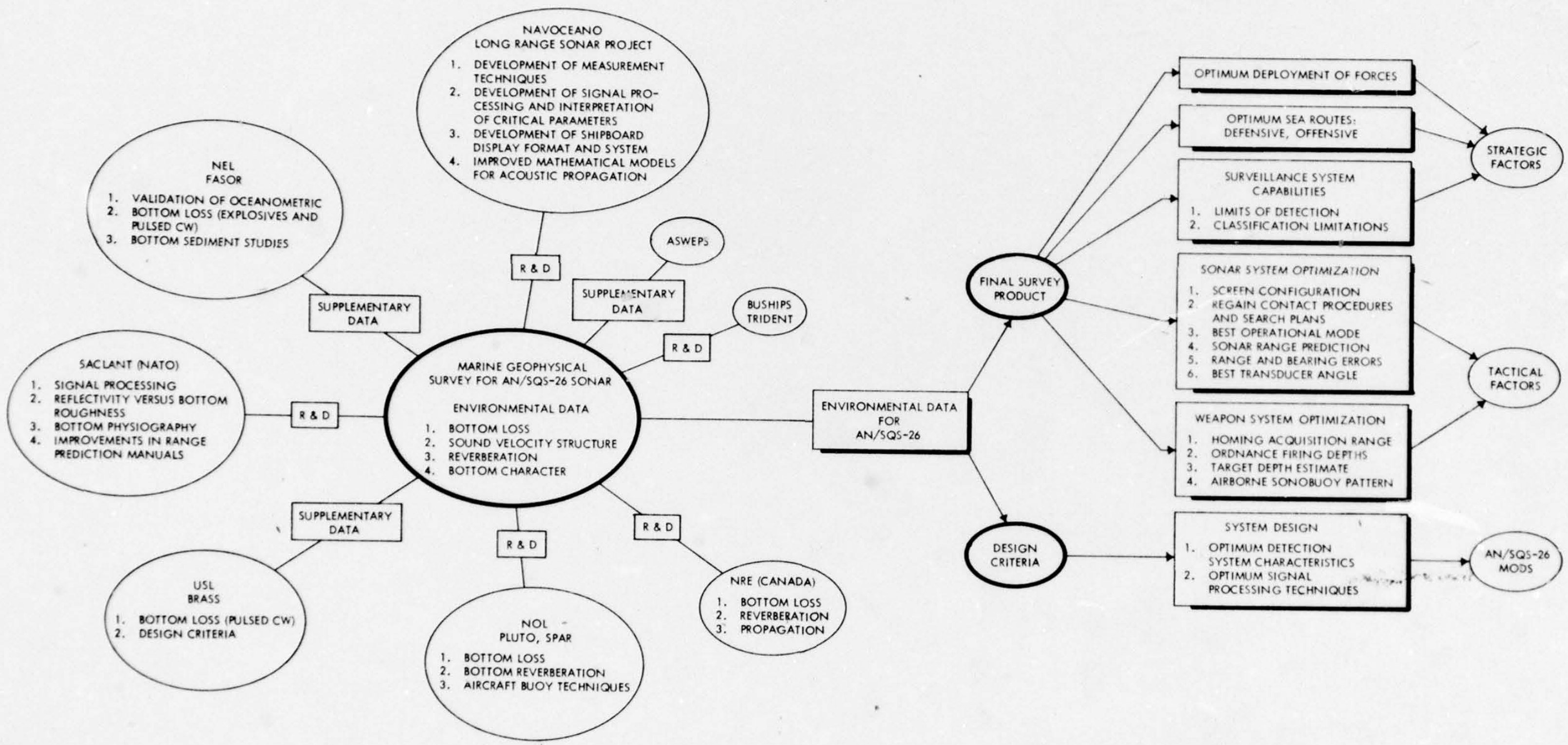
What about multipath, energy splitting, multiple arrivals et al?

7. INTERRELATED PROGRAMS

The conduct of this survey program requires interplay between the Marine Geophysical Survey and other groups engaged in anti-submarine warfare programs. An illustration of the relationships is shown in Figure 5. There will be a free exchange of measurement techniques, data holdings and requirements, research and development findings, and the applications of research and development findings.

The object of the Marine Geophysical Survey is to provide information for the AN/SQS-26 sonar. The results will be of immediate benefit to the SUBROC, BQQ-2, and many other existing ASW programs, as well as to future naval warfare programs such as SEA HAWK.

This data will also contribute significantly to the general expansion of knowledge of the operating oceanic environment, and thus will be of tremendous benefit to very many of the Navy's basic research programs that are concerned with effects of the environment.



Can't lose!

INTERFACING AND FLOW DIAGRAM

FIGURE 5